

FARM MECHANIZATION AND LABOUR DISPLACEMENT IN PADDY CULTIVATION: EVIDENCE FROM TAMIL NADU

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ABSTRACT

Farm mechanization has also led to more timeliness and efficiency of farm operations but has also created a concern regarding availability of labour, displacement of labour and off-farm employment of agricultural labourers. The study was conducted during the year 2025-2026 in Chengalpattu district of Tamil Nadu by following an ex post facto research design. The data were collected from 120 agricultural labourers through a pre-tested structured interview schedule. The data were analysed using frequency, percentage, mean, standard deviation, coefficient of variation, Pearson's Chi-square test and ranking technique. The study concluded that 55.83 per cent respondents were opined that manual agricultural labour is not readily available, whereas 60.00 per cent and 53.33 per cent reported that machinery operation labour and machinery repair services labour were readily available, respectively. Labor displacement due to farm mechanization was maximum in harvesting (95.83%), followed by ploughing (91.67%), threshing (90.00%) and transplanting (85.00%). Pearson's Chi-square test results showed significant relationship between farm mechanization and labour displacement. The major non-farm employment avenues adopted by the labourers were brick industry, hotels, bakery and tea shops and the service sector. Farm mechanization resulted into decreased dependence on manual labour and also increased employment for skilled labour related to machinery operation. Farm mechanization resulted into more diversity in occupations for the agricultural labourers.

KEYWORDS: Farm Mechanization, Agricultural Labourers, Labour Displacement, Labour Availability, Paddy Cultivation, Non-Farm Employment, Occupational Diversification.

INTRODUCTION

Agricultural development cannot be complete without including farm mechanization. Farm mechanization means the use of power and machinery to perform farm operation and processes. This enhances the productivity of farm work, reduced human drudgery, accelerated the operation of various operations and improved efficiency of the entire system. Agriculture is the principal occupation of the majority of population of India, accounting for the employment of 54.60 percent workforce (Census of India, 2011). Paddy is one of the labour-intensive crops and significant number of labours are required for preparing the field, sowing, transplanting, weeding, harvesting and threshing. In the past two decades, the trend of labour migration from rural areas to the urban areas has increased with large numbers of farmers aging over time, a rise in the wage rates of agriculture, and the availability of other off-farm employment opportunities in rural areas. All these factors are leading to a deficiency in the availability of labour in agriculture sector of the country. For this, the use of tractors, power tillers, paddy transplanters, weeders, combine harvesters, threshers etc. Is increased so as to over-come the deficiency in labour and to make the cultivation more profitable.

In this regard, Government of India through the 'Sub-Mission on Agricultural Mechanization' (SMAM) initiative promotes farm mechanization by providing subsidy on machinery and creating favourable environment for custom hiring centres (Department of Agriculture & Farmers Welfare, 2024). Previous studies shows that the mechanization increases input use efficiency, reduces the cost of cultivation and improves timeliness of operation (Tiwari *et al.*, 2019; Mehta *et al.*, 2019). Further, accessibility and availability of the machinery services greatly influenced the adoption of farm mechanization (Buttar *et al.*, 2023). The utilization of mechanical power reduces dependence on human and animal power, and improves agricultural productivity (Lohan *et al.*, 2015). As mechanization is a force that changes demand for labour and it can have a displacement effect on labourers who were previously working in those particular tasks, it may also create new employment opportunities like custom hiring, machinery repairing and operating the machines (Debnath and Nayak, 2022). A considerable body of research has focused on the productivity and cost effectiveness of farm mechanization. However, relatively fewer studies explored on the availability of labour, displacement of labour and

occupational mobility of farm labour in a labour abundant agricultural country like Tamil Nadu. The present study aims to investigate the impact of farm mechanization on the availability of labour, displacement of labour and the changes in occupational structure among the farm labourers in Chengalpattu district of Tamil Nadu by using an ex-post facto research design. The study hypothesizes that farm mechanization is significantly associated with labour displacement and occupational diversification among farm labourers.

METHODOLOGY

This study was conducted during the year 2026 in Chengalpattu district of Tamil Nadu to evaluate the effect of farm mechanization on labour availability, labour displacement in paddy cultivation and accessibility to non-farm employment opportunities among the agricultural labourers. This was a cross-sectional study, undertaken in order to make an evaluation of the situation that exist at present without making any deliberate efforts to change the independent variables in question, thus an ex-post facto research design was adopted. The study was carried out in Chengalpattu district selected purposively because it is one of the major paddy growing districts in Tamil Nadu, with the extensive use of farm machinery. In this study two blocks, Maduranthagam and Thirukazhukundram were selected purposively, because these blocks are predominantly paddy growing areas and where farm mechanization is widely practiced. From each selected block two villages were selected by purposive sampling method and thirty agricultural labourers were selected from each village, resulting in a total sample of 120 respondents.

Primary data were collected through personal interview by using a pre-tested structured interview schedule. The interview schedule was pre-tested in a non-sample area before the field investigation to check the clarity, consistency, relevance and sequence of the questions. Based on the feedback obtained during the pre-test, necessary modifications were incorporated and final schedule was administered to the respondents. The schedule collected data on socio-economic character of respondents, availability of labour, displacement of labour in major paddy cultivation operations and access to non-farm employment opportunities. Secondary data were collected from Department of Agriculture and Farmers Welfare, Government of Tamil Nadu and other published sources. Labour availability was measured on a three-point continuum ranging from readily available (3), not readily available (2), not at all available (1). Access to non-farm employment opportunities was measured in terms of occupational sectors where respondents worked and rank order was obtained for the sector based on percentage of respondents employed in that sector. Coded and classified data were analysed using the software packages like IBM SPSS Statistics software. Frequency, percentage, mean, standard deviation and coefficient of variation were worked out to summarise the data on respondent's socio-economic characteristics, extent of labour availability and labour displacement. Person's Chi-square (χ^2) test was applied to test the significance of difference in the observed distribution of labour availability and labour displacement. The formula for calculation of Chi-square is given below:

$$\chi^2 = \frac{\sum (O-E)^2}{E}$$

where, χ^2 denotes the Chi-square statistic; O is the observed frequency and E is the expected frequency. All statistical tests were performed at 5 per cent significance level ($p < 0.05$).

RESULT AND DISCUSSION

This section deals with the study findings on the impact of farm mechanization on agricultural labourers in paddy cultivation. The collected data were systematically analysed with the help of suitable statistical tools like frequency, percentage, mean, standard deviation, coefficient of variation, Pearson's Chi-square test and ranking technique. The findings are discussed under separate headings according to the objectives of the study and interpreted to understand the effects of farm mechanization on labour availability, labour displacement and access to non-farm employment opportunities.

1. Labour Availability

Labour availability was an important variable as it indicates the availability of labour needed for manual agricultural operations, machinery operation and machinery repair services. The data were analysed in terms of frequency and percentage and results are presented in Figure 1.

Figure.1 Distribution of respondents according to Labour Availability



Figure 1 indicated that more than half of the respondent's 55.83 percent stated that the labour for manual agricultural workers is not readily available, while around one fourth of the respondent's 23.33 percent stated that labour for manual agricultural works is readily available and the remaining 20.84 percent said labour for manual agricultural works is not at all available. Whereas the three fifth of the respondent's 60.00 percent responded that labour for the machinery operation is readily available and around one third of the respondent's 31.67 percent said that labour for machinery operation is not readily available, while 8.33 percent respondents said labour for machinery operation is not available at all. Likewise, more than half of the respondent's 53.33 percent respondents said labour for the repair and maintenance of the machinery is readily available, whereas 35.00 percent said labour for the repair and maintenance of the machinery is not readily available and 11.67 percent of respondents said that labour for repair and maintenance of the machinery is not available at all. It also suggests that the labour for the machinery operation and repair works was more available compared to manual agriculture works among the respondents.

2.Labour Displacement in Farm Activities

Labour displacement was considered as an important variable to assess the impact of farm mechanization on manual labour requirements in paddy cultivation. The magnitude of displacement in critical farm operations such as ploughing, puddling, sowing, transplanting, weeding, spraying, irrigation, harvesting and threshing was studied. The responses were recorded as Yes (1) and No (2) and the data were analysed using frequency, percentage, mean, standard deviation, coefficient of variation and Pearson's Chi-square test. Table 1 displays the results.

Table 1. Distribution of respondents according to Labour Displacement in Farm Activities

S.No	Farm Operation	Labour Displaced (Yes)		Labour Not Displaced (No)		Mean	SD	CV (%)	X ² value (df=1)
		No.	%	No.	%				
1.	Ploughing	110	91.67	10	8.33	1.08	0.28	25.93	83.333**
2.	Puddling	98	81.67	22	18.33	1.18	0.39	33.05	48.133**
3.	Sowing	76	63.33	44	36.67	1.37	0.48	35.04	8.533**
4.	Transplanting	102	85.00	18	15.00	1.15	0.36	31.30	58.800**
5.	Weeding	88	73.33	32	26.67	1.27	0.44	34.65	26.133**
6.	Spraying	80	66.67	40	33.33	1.33	0.47	35.34	13.333**
7.	Irrigation	52	43.33	68	56.67	1.57	0.50	31.85	2.133 NS
8.	Harvesting	115	95.83	5	4.17	1.04	0.20	19.23	100.833**
9.	Threshing	108	90.00	12	10.00	1.10	0.30	27.27	76.800**

Note: **Significant at 1 per cent level ($p < 0.01$); NS- Non-significant

Table 1 show that highest percentage of respondent 95.83 % have indicated of labour displacement for harvesting operation followed by ploughing 91.67% and threshing 90.00 %. Similarly, 85.00 per cent of the respondents have stated of labour displacement for transplanting followed by puddling 81.67 %, weeding 73.33%, spraying 66.67 % and sowing 63.33%. In contrary to this over half 56.67% of respondents has not displaced of labour for irrigation operation followed by 43.33% labour displacement for the irrigation.

The mean values vary from 1.04 to 1.57 thus indicating considerable variation in the extent of labour displacement among the selected farm operations. Lowest mean value was for harvesting operation (1.04) followed by ploughing (1.08) and threshing (1.10) thus indicating higher extent of labour displacement whereas the highest mean value for irrigation operation (1.57) indicating the less extent of labour displacement. The standard deviation values range from 0.20 to 0.50 while the coefficient of variation value range from 19.23 to 35.34 per cent indicating the moderate variation among the responses of respondents for different farm operations selected. The result of Pearson's Chi-square analysis for the extent of labour displacement for selected farm operations indicated that ploughing, puddling, sowing, transplanting, weeding, spraying, harvesting and threshing are differ significantly at one per cent level of significance ($p < 0.01$) while for irrigation does not differ significantly.

3.Access to Non-farm Employment Opportunities

The access to the non-farm employment opportunities was taken as an important variable in the present study as it indicates the alternative livelihood options available to the agricultural labourers due to increasing adoption of farm mechanization. The respondents were requested to indicate the major non-farm sectors in which they were employed. The data were analysed by frequency and ranking technique. The results are presented in Table 2.

Table.2 Ranking of Non-farm Employment Opportunities Accessed by Agricultural Labourers (N=120)

S.No.	Non- farm employment sector	Respondents (No.)	Rank
1.	Brick industry	20	I
2.	Hotels, bakery and tea shops	18	II
3.	Service sector (shops, xerox, etc.)	14	III

4.	Cotton and textile mills	12	IV
5.	Transport sector	11	V
6.	Rice mills	10	VI
7.	Engineering units	9	VII
8.	Furniture and steel fabrication	8	VIII
9.	Wood and paper industry	6	IX
10.	Others	6	IX
11.	Government jobs	4	X

It has been observed that various sources of non-farm employment are taken by the agricultural labourers. Among the various sources, brick kiln sector provided employment to 20 respondents, which is first category followed by hotels, bakery and tea shops (18 respondents) and services sector (shops and Xerox centres 14 respondents). These sectors are major one for the sources of employment in the non-farm sector. Industrial based activities were accessed by agricultural labour in various sources namely Cotton & Textiles Mills (12 respondents), transport sector (11 respondents) and Rice Mills (10 respondents). It was followed by respondents engaged in engineering unit (9 respondents), furniture and steel fabricating works (8 respondents) and wooden and paper mill activities (6 respondents). This clearly indicated variety of occupational groups accessed by the agricultural labourers apart from the agricultural occupations. By contrast, formal employment sectors like govt service (4 respondents), banking service (2 respondents) sectors were secured by fewer respondents of these groups. From the above it is evident that more respondents of agriculture labour group have taken non-farm employment sector which includes some non-farm service sector and semi-skilled and informal employment sector. By order of preference, these include brick making industry, hotel/tea stall/bakery service and general service sector were the predominant non-farm employment sector for agriculture labour.

DISCUSSION

Agricultural mechanization had significant and mixed effects on farm labour in terms of labor availability, substitution of manual labour by machinery, creation of machinery-related employment, and change in rural livelihoods. The current study showed a change in the pattern of labour utilization in paddy cultivation owing to mechanization. Even though the demand for labour has decreased in ploughing, transplanting, harvesting and threshing operations due to mechanization, there is an increased demand for skilled machinery operators and machinery maintenance workers. Therefore, mechanization not replaced labor totally, rather changed the pattern of labor demand. The study findings are in conformity with those of Lohan *et al.*, (2015) who reported increased production efficiency through less dependence on human and animal labour. Amare and Endalew (2016) stated that mechanization increased labour productivity, created opportunities in machinery operation and maintenance, and reduced drudgery of farmers. The degree of displacement of labor differs among different paddy crop operations based on the level of mechanization. Tractors, paddy transplanters, combine harvesters and threshers contributed largely to the decrease in labor requirements in labor intensive activities such as ploughing, transplanting, harvesting and threshing. This finding is consistent with Debnath and Nayak (2022) and Raina *et al.*, (2021), who reported that mechanization had resulted in higher productivity and lower labour requirement.

Reddy and Angadi (2018) pointed out that mechanization gaps for paddy transplanters and combine harvesters were higher and that these machines have growing need for more efficient paddy operations. The finding also supports Ravi Shankar Chand Reddy *et al.*, (2018) that mechanization helped farmers overcome the problem of labor scarcity, reduce drudgery, improve operational efficiency. Also, they pointed out that farmers showed a good knowledge on combine harvester, power tiller, sprayer and other farm machinery in order to promote mechanization. Relatively lower labor displacement was observed in spraying and irrigation. Baruah *et al.*, (2025) reported higher mechanization in threshing and field preparation compared to transplanting, harvesting and weeding operations based on the choice of the farmers and local conditions. Further, the study showed that mechanization enhanced occupational diversification, as the farm labourers are increasingly shifting towards non-farm employment in sectors such as textile, restaurants, bakeries, transports, brick factory etc. This result is in agreement with Baruah *et al.*, (2025) who revealed that increasing labour scarcity, wages, and drudgery motivate to use agricultural machinery while factors such as farm size, extension contact, access to credit, training, and farmer's choice influenced adoption of mechanized agricultural machinery.

The study results are also in line with Ahmad and Murtaza (2021) who reported that farm mechanization substituted the human labor and provided the impetus for the movement of labor out of agriculture towards non-farm activities. The findings also revealed an inverse relationship between mechanization and women labor participation in agriculture and hence the process of technological change leads to reallocation of rural labor and change in composition of labor. In sum, farm mechanization impacts the rural labour market by substituting labour in many farm operations and increasing the demand for machine operators, maintenance staff and inducing reallocations of labour and occupational shifts towards non-farm employment.

CONCLUSION

The findings demonstrate that show that farm mechanization in rice production affects agricultural labourers from several dimensions; namely labour availability, labour displacement and access to non-farm opportunities. Results reveal that mechanized operations create remarkable changes in labour demand particularly at labour intensive operations but generate new job opportunities concerning operation, repairing of machineries and other vocations simultaneously. Moreover, degree of labour replacement differs according to operation and indicate change rather than substitution of agricultural demand of labourers due to mechanization. Furthermore, variety of access in different non-farm sectors suggests change in employment patterns of agricultural labourers. Results will be valuable to researchers, extensionists

and policy-makers in exploring labour transition during agricultural mechanization, planning for human capital development and for providing inclusive employment alternatives and sustainable rural life style.

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